

Abstract:

Elastic nonlinear effects, which cause frequency spectral broadening and the effects of the presence of the Slow-Wave in the reservoir rocks, are investigated. The creation of new frequencies due to elastic nonlinearity of the reservoir rocks and their presence in the reflected seismic signals is used to map the location and extent of the reservoir formations. The large differences in the velocities of the Compressional Wave and the Slow-Wave cause changes in their reflection and refraction characteristics. The reflection due to Slow-Wave appears as a low-frequency artifact, delayed in time. The delay time of this artifact is used to calculate the Slow-Wave velocity and the tortuosity of the reservoir rocks. Based on the tortuosity and the wellbore data, permeability can be estimated.

15

20

References cited:

Castagna, John P., 2003, Instantaneous spectral analysis: Detection of low-frequency shadows associated with hydrocarbons: The Leading Edge.

- 5 Biot, M. A., 1956, Theory of propagation of elastic waves in a fluid saturated porous solid: Journal Acoustic Society of America.

Scheidegger, A. E. 1960, Physics of flow through porous media: University of Toronto.

10

Goloshubin, Geladi M., et al, Seismic low-frequency effects from oil-saturated reservoir zones: SEG 2002.

- 15 Klimentos, T., McCann, C. 1988, Why is the Biot Slow Compressional Wave not observed in real rocks. Geophysics 53, 1605.

Donskoy, D. M., 1987, Nonlinear acoustic waves in porous media in the context of Biot's theory. Journal Acoustic Society of America.

Johnson, P.A., Rasolofosaon, P.N.J.; Manifestation of Nonlinear Elasticity in Rock: Convincing Evidence Over Large Frequency and Strain Intervals from Laboratory Studies; Nonlinear Processes in Geophysics.

5 Johnson, P.A., Shankland, T.J.; Nonlinear Generation of Elastic Waves in Crystalline Rock; Journal of Geophysical Research.

Meegan, G.D., Johnson, P.A.; Observation of Nonlinear Elastic Wave Behaviour in Sandstone; Journal Acoustic Society of America.

10

Johnson, P.A., McCall, K.R.; Observations and Implications of Nonlinear Elastic Wave Response in Rock; Geophysical Research letters.

U.S. Patent Documents

15 6,175,536 Jan., 2001 Khan 367/32.